CLAIMS:

What is claimed is:

1. A dual-channel, double-filtering, multi-pass optical spectrum analyzer comprising:-
   (i) a diffraction grating (DG);
   (ii) first and second input ports (P1′, P1″) for directing first and second input light beams (LR, LT), respectively, onto the diffraction grating in a first plane for dispersion a first time;
   (iii) polarization-decomposing means (PDM) for decomposing a single light beam into first and second components having mutually-orthogonal linear states of polarization and supplying said first and second components to said first and second input ports as said first and second input light beams (LR, LT), respectively,
   (iv) a retroreflector means (RAM1) for receiving the first and second dispersed light beams and returning same to the diffraction grating in a second plane for dispersion a second time;
   (v) first and second intermediate output ports (P2′, P2″) for receiving the first and second twice-dispersed light beams, respectively;
   (vi) first and second secondary input ports (P3′, P3″) coupled to the first and second intermediate output ports, respectively, by polarization-maintaining waveguide means (PMF2′, PMF2″) and for directing the twice-dispersed first and second light beams onto the diffraction grating in a third plane for dispersion a third time, with their states of polarization having a predetermined orientation relative to the states of polarization of the first and second light beams when first incident upon the diffraction grating, the retroreflector means (RAM1) reflecting the three-times-dispersed first and second light beams back to the diffraction grating means in a fourth plane for dispersion a fourth time;
   (vii) first and second output ports (P4′, P4″) for receiving the first and second light beams, respectively, after dispersion the fourth time, the first, second,

third and fourth planes being parallel to each other and the dispersion plane and spaced from each other in a direction perpendicular to the dispersion plane;

(viii) means (TT) for rotating at least one of the first retroreflector and the grating to effect wavelength scanning;

(ix) first and second detectors (D′, D″) for receiving the first and second light beams from the first and second output ports (P4′, P4″), respectively, and converting same to first and second electrical signals, respectively; and

(x) microprocessor means (MP) coupled to said rotating means (TT) and to the detectors (D′, D″) for controlling rotation of the first retroreflector (RAM1) and processing the first and second electrical signals;

the arrangement being such that, each time the first and second light beams are incident upon the diffraction grating, their linear states of polarization are substantially parallel to each other and the dispersion planes for all wavelengths within an operating band of the optical spectrum analyzer.

2. An optical spectrum analyzer according to claim 1, wherein said first and second secondary input ports (P3′, P3″) and said first and second output ports (P4′, P4″) comprise a rectangular fiber array and share a single optical collimating/focussing means having an optical axis extending through the centre of the rectangular fiber array, the first and second secondary input ports (P3′, P3″) being in a first plane substantially perpendicular to the dispersion plane and the first and second output ports (P4′, P4″) being in a second plane substantially perpendicular to the dispersion plane, the first secondary input port (P3′) and the first output port (P4′) being disposed adjacent each other in another plane that is parallel to the diffraction plane, and the second secondary input port (P3″) and the second output port (P4″) being disposed in yet another plane parallel to the diffraction plane.

3. An optical spectrum analyzer according to claim 1, wherein the first and second secondary input ports (P3′, P3″) comprise a first fiber array disposed in the focal plane of a

single collimating lens means (L3) and the first and second output ports (P4′, P4″) comprise a second fiber array disposed in the focal plane of a single focussing lens means (L4).

4. An optical spectrum analyzer according to claim 1, wherein the first and second input ports (P1′, P1″) and the first and second secondary input ports (P3′, P3″) are each associated with a respective one of a set of four separate collimating lens means (L1′, L1″, L3′, L3″) and the first and second intermediate output ports (P2′, P2″) and first and second output ports (P4′, P4″) are each associated with a respective one of a set of separate focussing lens means (L2′, L2″, L4′, L4″).

5. An optical spectrum analyzer according to claim 1, further comprising a second retroreflector (RAM2) for providing for dispersion of the first and second light beams two more times before reaching the first and second output ports, respectively.

6. An optical spectrum analyzer according to claim 5, wherein the second retroreflector (RAM2) is disposed for receiving the first and second light beams after they have been directed into the monochromator by the first and second secondary input ports, dispersed by the grating, reflected by the first retroreflector means and dispersed again by the grating, and returning the first and second light beams for dispersion yet again by the grating, reflection yet again by the first retroreflector, and dispersion once more by the grating before reading said first and second output ports (P4′, P4″).

7. An optical spectrum analyzer according to claim 1, wherein the first and second input ports (P1′, P1″) direct the first and second light beams (LR, LT) onto said grating (DG) with their linear states of polarization parallel to each other and parallel to a plane of dispersion of the diffraction grating, and such that, when directed onto the diffraction grating by the first and second secondary input ports (P3′, P3″) the linear SOPs of the twice-dispersed light-beams are parallel to the linear SOPs of the first and second input light beams when incident upon the diffraction grating (DG) the first time.

8. An optical spectrum analyzer according to claim 1, wherein a first stage comprising the optical path between the first and second input ports (P1′, P1″) and the first and second intermediate output ports (P2′, P2″) and a second stage comprising the optical path between the first and second secondary input ports (P3′, P3″) and the first and second output ports (P4′, P4″), each have a Gaussian-like optical filter response, the optical filter response linewidth of one stage being greater than that of the other stage, the first and second input ports and the first and second secondary input ports being aligned so that, in both stages, the light beams are incident upon the grating at the same angle of incidence.

9. A dual-channel, double-filtering, multi-pass monochromator comprising:-

(i) a diffraction grating (DG);

(ii) first and second input ports (P1′, P1″) for directing first and second input light beams (LR, LT), respectively, onto the diffraction grating in a first plane for dispersion a first time;

(iii) a retroreflector means (RAM1) for receiving the first and second dispersed light beams and returning same to the diffraction grating in a second plane for dispersion a second time;

(iv) first and second intermediate output ports (P2′, P2″) for receiving the first and second twice-dispersed light beams, respectively;

(v) first and second secondary input ports (P3′, P3″) coupled to the first and second intermediate output ports, respectively, by polarization-maintaining waveguide means (PMF2′, PMF2″) for directing the twice-dispersed first and second light beams onto the diffraction grating in a third plane for dispersion a third time, with their states of polarization having a predetermined orientation relative to the states of polarization of the first and second light beams when first incident upon the diffraction grating, the retroreflector means (RAM1) reflecting the three-times-dispersed first and second light beams back to the diffraction grating means in a fourth plane for dispersion a fourth time; and

(vi) first and second output ports (P4′, P4″) for receiving the first and second light beams, respectively, after dispersion the fourth time, the first, second, third and fourth planes being parallel to each other and the dispersion plane and spaced from each other in a direction perpendicular to the dispersion plane.

10. A monochromator according to claim 9, wherein said first and second secondary input ports (P3′, P3″) and said first and second output ports (P4′, P4″) comprise a rectangular fiber array and share a single optical collimating/focussing means having an optical axis extending through the centre of the rectangular fiber array, the first and second secondary input ports (P3′, P3″) being in a first plane substantially perpendicular to the dispersion plane and the first and second output ports (P4′, P4″) being in a second plane substantially perpendicular to the dispersion plane, the first secondary input port (P3′) and the first output port (P4′) being disposed adjacent each other in another plane that is parallel to the diffraction plane, and the second secondary input port (P3″) and the second output port (P4″) being disposed in yet another plane parallel to the diffraction plane.

11. A monochromator according to claim 9, wherein the first and second secondary input ports (P3′, P3″) comprise a first fiber array disposed in the focal plane of a single collimating lens means (L3) and the first and second output ports (P4′, P4″) comprise a second fiber array disposed in the focal plane of a single focussing lens means (L4).

12. A monochromator according to claim 9, wherein the first and second input ports (P1′, P1″) and the first and second secondary input ports (P3′, P3″) are each associated with a respective one of a set of four separate collimating lens means (L1′, L1″, L3′, L3″) and the first and second intermediate output ports (P2′, P2″) and first and second output ports (P4′, P4″) are each associated with a respective one of a set of separate focussing lens means (L2′, L2″, L4′, L4″).

13. A monochromator according to claim 9, further comprising a second retroreflector (RAM2) for providing for dispersion of the first and second light beams two more times before reaching the first and second output ports, respectively.

14. A monochromator according to claim 13, wherein the second retroreflector (RAM2) is disposed for receiving the first and second light beams after they have been directed into the monochromator by the first and second secondary input ports, dispersed by the grating, reflected by the first retroreflector means and dispersed again by the grating, and returning the first and second light beams for dispersion yet again by the grating, reflection yet again by the first retroreflector, and dispersion once more by the grating before reading said first and second output ports (P4′, P4″).

15. A monochromator according to claim 9, wherein the first and second input ports (P1′, P1″) direct the first and second light beams (LR, LT) onto said grating (DG) with their linear states of polarization parallel to each other and parallel to a plane of dispersion of the diffraction grating, and such that, when directed onto the diffraction grating by the first and second secondary input ports (P3′, P3″) the linear SOPs of the twice-dispersed light-beams are parallel to the linear SOPs of the first and second input light beams when incident upon the diffraction grating (DG) the first time.

16. A monochromator according to claim 9, wherein a first stage comprising the optical path between the first and second input ports (P1′, P1″) and the first and second intermediate output ports (P2′, P2″) and a second stage comprising the optical path between the first and second secondary input ports (P3′, P3″) and the first and second output ports (P4′, P4″), each have a Gaussian-like optical filter response, the optical filter response linewidth of one stage being greater than that of the other stage, the first and second input ports and the first and second secondary input ports being aligned so that, in both stages, the light beams are incident upon the grating at the same angle of incidence.

17. A double-filtering, multi-pass monochromator comprising:-

(I) a diffraction grating;

(ii) a first port for directing an input light beam onto the diffraction grating for dispersion a first time;

(iii) a retroreflector means for receiving the dispersed light beam and returning same to the diffraction grating for dispersion a second time;

(iv) a second port for receiving the twice-dispersed light beam;

(v) a third port coupled to the second port by a waveguide and for directing the twice-dispersed light beam onto the diffraction grating for dispersion a third time, the retroreflector means reflecting the thrice-dispersed light beam back to the diffraction grating for dispersion a fourth time;

(vi) a fourth port for receiving the four-times dispersed light beam from the diffraction grating.